Why SETI Is Science and UFOlogy Is Not

A Space Science Perspective on Boundaries

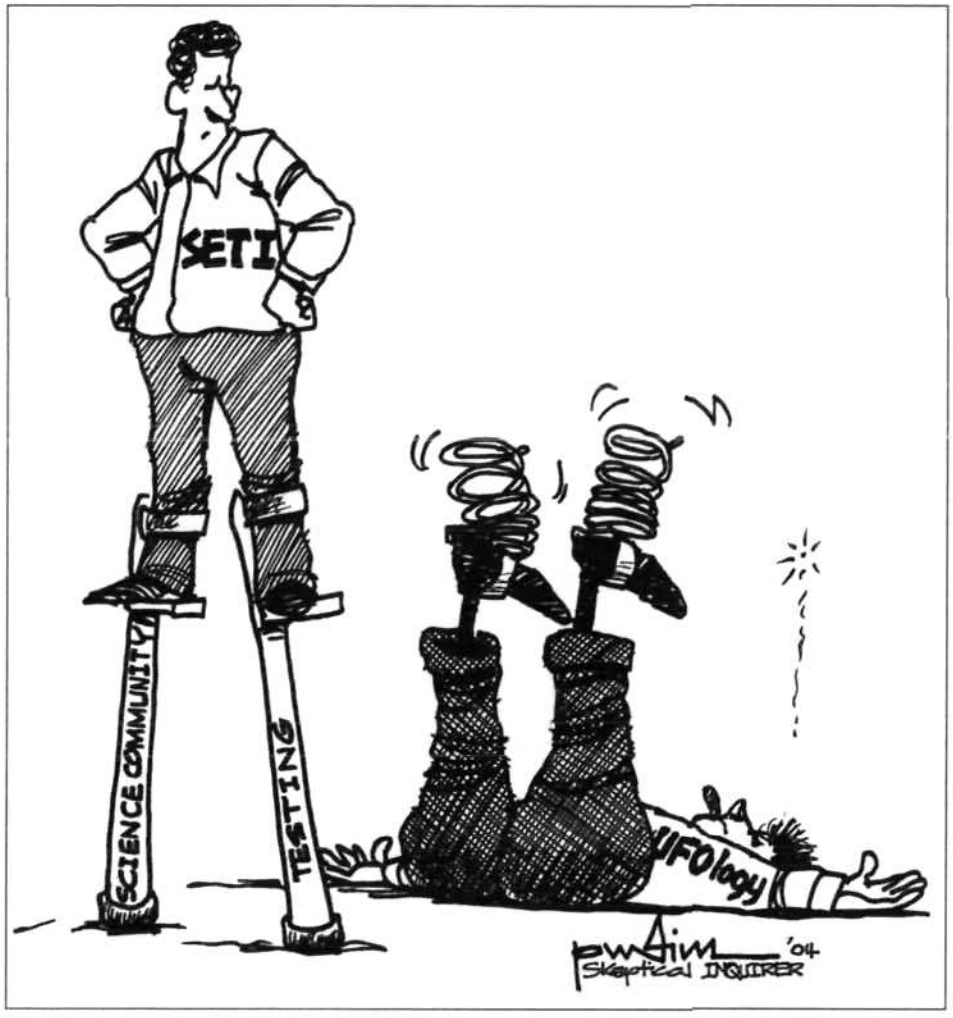
Understanding the differences between science and pseudoscience is a fundamental critical thinking skill but often isn't as easy as it sounds. Using SETI and UFOlogy as case studies, a space scientist examines what is meant by science *and why some highly speculative ideas are part of the scientific mainstream while others are not.*

MARK MOLDWIN

One of the goals of science education is to provide the critical thinking skills that are necessary to distinguish fact from fallacy, legitimacy from fraud, and science from pseudoscience. Scientifically literate people understand how science works and does not work, how to identify strengths and weaknesses in arguments, and how to critically examine data in order to make decisions despite uncertainties. So how does one define the differences between science and pseudoscience? To the discomfort of many, the line can be fuzzy. Like the old saying about pornography, rational thinkers like to believe they know pseudoscience when they see it.

Often, the argument is posited that science follows the

scientific method (in fact, some hold that this Baconian idea is the definition of science) whereas pseudoscience does not. This is clearly not the case, as readers of SKEPTICAL INQUIRER know, since many pseudoscientific claims are routinely put to the scientific-method test, and debates rage on the results of studies that purport pseudoscientific claims published in the scientific literature (e.g., an article about "memory water" that ran in *Nature* [Davenas et al. 1988], another on the power of intercessory prayer in healing that ran in the *Archives of Internal Medicine* [Harris et al. 1999], etc.). Often, referees and editors cannot find any methodological errors in the studies despite having the results fly in the face of conventional science. The critics are then left to insinuate fraud, observer bias, or improper controls.



If science is not defined by the scientific method, how can one differentiate between science and pseudoscience? Philosophers of science have long considered this "demarcation" problem (see, for example, Bunge 1984). As a working scientist, I suggest two characteristics of science that can be used to make that distinction. The first deals with the community of scientists, and the second goes to the essence of science—namely the constant testing of any scientific idea against reality. The first, the willingness of scientists to practice as part of the community of science, means having the appropriate educational credentials, undergoing peer review of proposed scientific ideas, discussing ideas at scientific meetings and conferences, and presenting results for peer review in respected journals. Those who attempt to practice outside the scientific community, called "scientific hermits" by Martin Gardner, attempt to avoid a critical assessment of their ideas. What they're attempting to avoid is the second characteristic of science in this discussion: namely, the constant testing of scientific ideas compared to previous understanding and observations. This testing has been described as subjecting an idea to "reality therapy" (Bauer 1992) and allows science to make universal statements agreed upon by all practicing scientists.

SETI and UFOlogy

As an illustrative example, let us examine the difference in attitudes toward SETI and UFOlogy in the scientific community. Slowly, over the last few decades, the search for extraterrestrial intelligence (SETI) has been given the imprimatur to join the ranks of legitimate science. In 2003, the SETI Institute was named a member of NASA's Astrobiology Institute (www.seti inst.edu) after a rigorous peer-review process. In addition, a search of Harvard's Astrophysical Data System for the keyword SETI listed over 600 refereed-journal articles, indicating the vigor of this research area. One of the premises of SETI is that life may have evolved elsewhere in the universe and some of that life may be intelligent enough to utilize electromagnetic radiation as a form of communication. Therefore, a systematic search of the sky in radio (or even other wavelengths) for evidence of intelligent life is justified.

The search for UFOs, on the other hand, is derided as pseudoscience, even though UFOlogists may consistently practice according to the scientific method (i.e., seek confirmable observational evidence, systematically discuss sources of error, etc.) and share a similar premise with SETI researchers—namely that intelligent life may have evolved elsewhere in the universe. Why the difference in the legitimacy of the two endeavors?

Mark Moldwin is Associate Professor of Space Physics in the Earth and Space Sciences Department and the Institute of Geophysics and Planetary Physics, the University of California, Los Angeles. E-mail: mmoldwin@ucla.edu.

SETI is part of the community of astronomy or astrobiology and is practiced by astronomers, physicists, and geophysicists. The methodology of SETI leads to useful scientific results even in the absence of discovery of intelligent life. In fact, the stated mission of the SETI Institute is "to explore, understand, and explain the origin, nature, and prevalence of life in the universe" a broad goal not predicated on the existence of other intelligent life in the universe.

In trying to clearly differentiate between science and pseudoscience, one often needs to go beyond each field's methodology and look more closely at its sociology and the willingness of its practitioners to constantly compare and test their ideas against our current understanding and observations.

UFOlogy *is not part of the community of astronomy,* astrobiology, or any other discipline, and its methodology, no matter how scientifically rigorous, will lead to no useful scientific results except in the singular case of the discovery of an alien spacecraft. One could argue perhaps that if UFOlogists became part of NASA's Near-Earth Object (NEO) community (the community of astronomers and geophysicists attempting to identify comets and asteroids) they would gain some legitimacy. However, most UFOlogists already claim evidence of ET visitations and expound on the conspiracy of mainstream science to hide their revelations as opposed to actually searching for evidence.

Reality Therapy

Another way to understand why it can be difficult to differentiate science and pseudoscience is to appreciate that there is a spectrum of science. Established, or "textbook," science has successfully stood the test of time to explain nature (it has been subjected repeatedly to "reality therapy"). There is also new science, sometimes called frontier science, which is made up of the recent discoveries, the new conjectures, and the latest proposals for extending current knowledge. Interesting frontier science is the science that makes *The New York Times* science page and often appears on the evening news. What scientists know, and the general population often does not, is that frontier science is frequently wrong. For example, the recent coverage of doomsday asteroids heading to Earth eventually became just another close call (see www.space.com/science astronomy/asteroid_scares_030909.html).

It takes time for frontier science to be examined and either validated or rejected (i.e., undergo reality therapy). Only after frontier science has successfully made its case does it slowly make its way into mainstream scientific thought. SETI began as frontier science. The hypotheses that there are other planetary systems; that some of these systems may have Earth-like planets; that life may be ubiquitous; and that, given enough time, intelligent life may have evolved elsewhere have each been analyzed and in some cases confirmed (e.g., we now have observed other planetary systems). UFOlogy can trace similar roots but goes a step further and suggests that intelligent life elsewhere has somehow been able to overcome interstellar distances to send physical probes to Earth.

So when one looks at the difference between SETI and UFOlogy, the two main differences are that *SETI operates within* the community of science whereas UFOlogy does not and that several SETI ideas have been explored observationally and validated. In addition, the premise of SETI is more likely (though still highly speculative) compared to UFOlogy, simply because it is more plausible to imagine a civilization communicating across interstellar distances with electromagnetic radiation rather than sending a physical ship with intelligent living beings. Of course, if an alien craft landed on Earth tomorrow, UFOlogy would instantly join the mainstream. Therefore, the boundary between pseudoscience and science is not necessarily immutable.

In trying to clearly differentiate between science and pseudoscience, one often needs to go beyond each field's methodology and look more closely at its sociology and the willingness of its practitioners to constantly compare and test their ideas against our current understanding and observations. Do they allow their work to be scrutinized and criticized by their scientific colleagues? Do they publish in peer-reviewed scientific journals? Have any advances in their field made it into scientific textbooks? The answers to these three questions are often good indicators of whether an area of study belongs in the realm of science or pseudoscience.

Note

The motivations for writing this essay were discussions in an undergraduate course at UCLA that I taught in the fall of 2002 and reading H.H. Bauer's *Scientific Literacy and the Myth of the Scientific Method.*

References

Bauer, H.H. 1992. *Scientific Literacy and the Myth of the Scientific Method.* Chicago: University of Illinois Press.

Bunge, Mario. 1984. What is pseudoscience? SKEPTICAL INQUIRER 9(1), Fall: 36–46.

Davenas, E., F. Beauvais, J. Amara, M. Oberbaum, B. Robinzon, A. Miadonnai, A. Tedeschi, B. Pomeranz, P. Fortner, P. Belon, J. Sainte-Laudy, B. Poitevin and J. Benveniste. 1988. Human basophil degranulation triggered by very dilute antiserum against IgE. *Nature* 333:816–818.

Harris, William S., Manohar Gowda, Jerry W. Kolb, Christopher P. Strychacz, James L. Vacek, Philip G. Jones, Alan Forker, James H. O'Keefe, Ben D. McCallister. 1999. A randomized, controlled trial of the effects of remote, intercessory prayer on outcomes in patients admitted to the coronary care unit. *Archives of Internal Medicine* 159:2273–2278. □